

Abstract

“Good health start with clean water” filtration of water with minerals such as Zinc (Zn) and Magnesium (Mg) is an integral part of existence life and contaminated water causes waterborne disease like diarrhea, typhoid and cholera due to presence of pathogenic bacteria like E. coli, S. typhi and V. cholera respectfully.

The aim is to develop nano-material embedded polyester nonwoven fabric-based water filter. Removal of bacteria is possible with combination of Silver nanoparticles (Ag NPs)/ Cu-MMT Clay, Zinc oxide Nanoparticles (ZnO NPs), Magnesium oxide (MgO NPs) due to their inherent antimicrobial activity. A Patented technique has been used first time to impregnate the nanoparticles inside polyester nonwoven fabric which gives high durability with controlled leaching of metal particles in filtered water.

Introduction

Gravity based filter

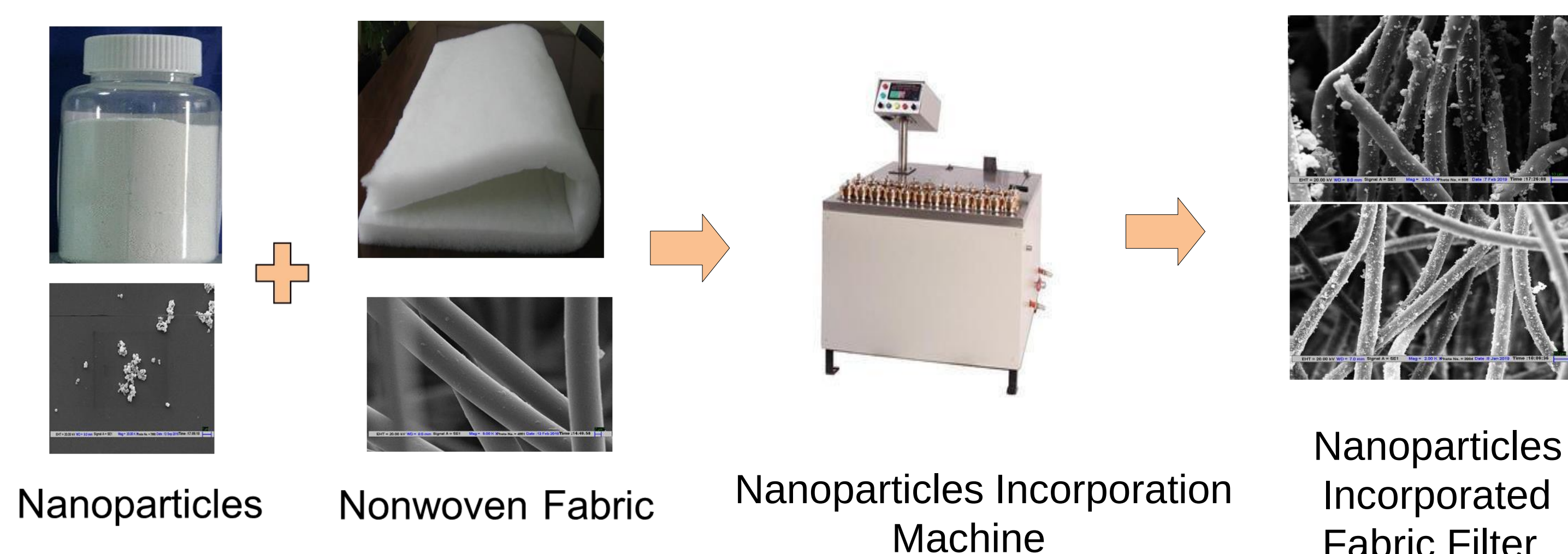
Nano materials Ag nanoparticles/Cu-MMT Clay, ZnO nanoparticles, MgO nanoparticles

Controlled Leaching with essential mineral enrich

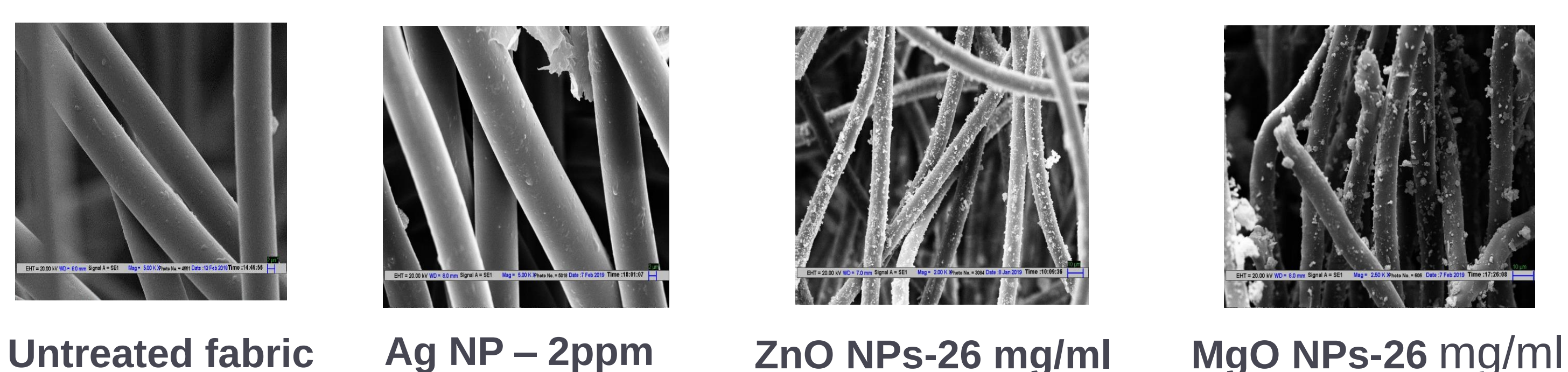
Safe for drinking follows WHO norms

Ag-0.1ppm, Zn- 5ppm, Mg- 30ppm

Materials and Methods



SEM images of Nanoparticles based fabric



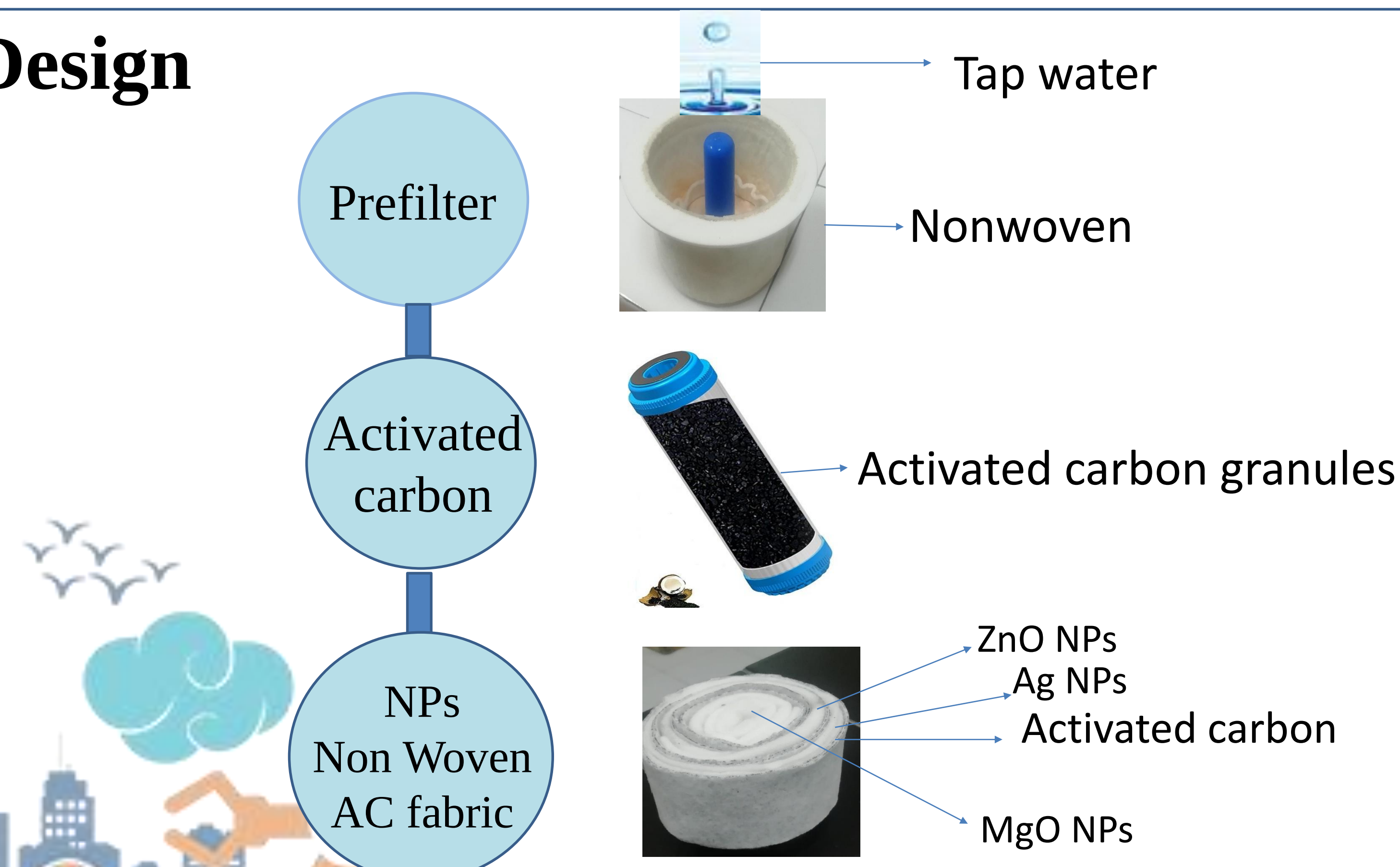
Conclusions

1. SEM & EDX analysis shows that ZnO, MgO and Ag NPs were successfully incorporated into fabric
2. ZnO, MgO and Ag NPs based fabric filters shows around 95% bacteria reduction efficiency towards E. coli within 30 min, 90 min and 10 min
3. Leaching result of metal particles in water after filtration follows WHO norms for all NPs based fabric filter at all concentration at flow rate 1L/hr./5cm²

Industrial Significance

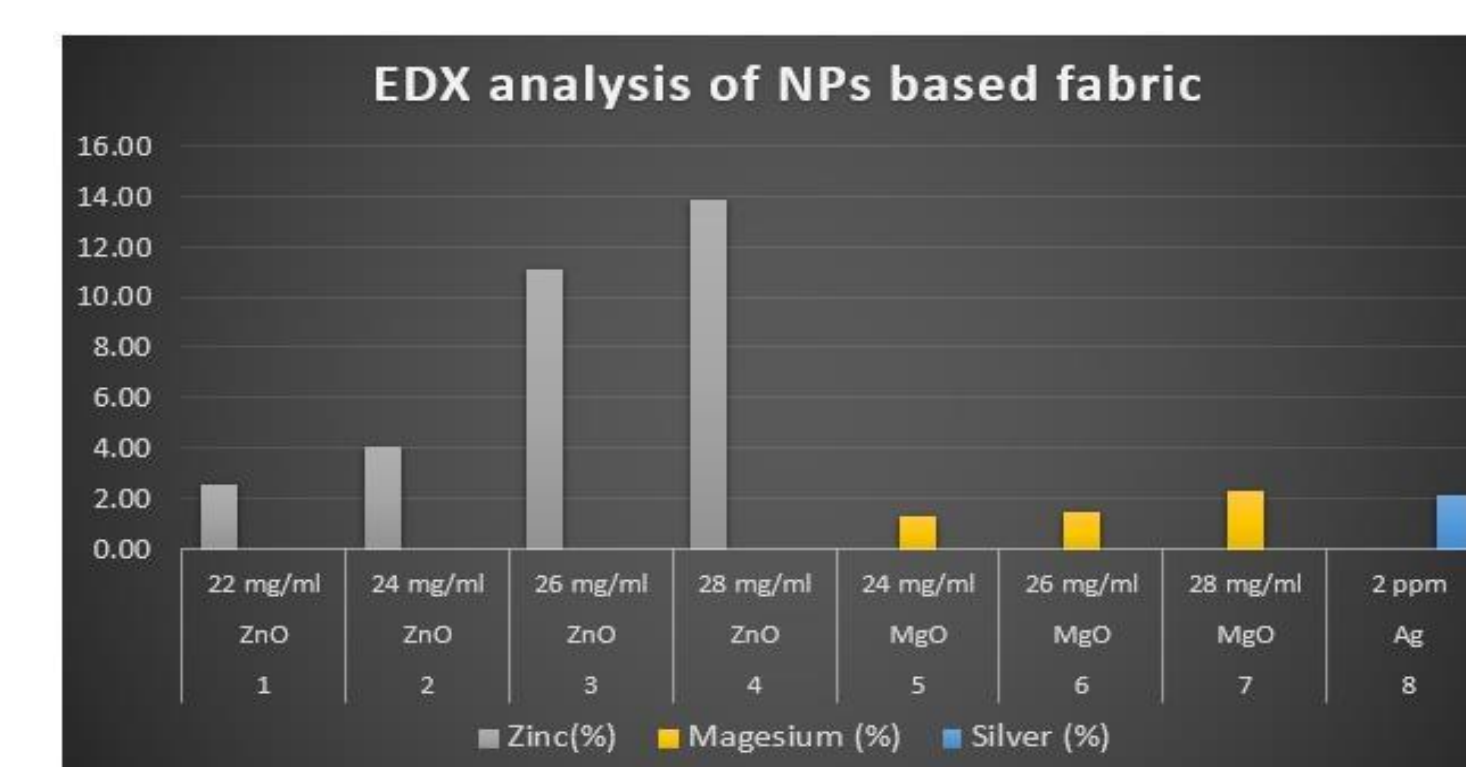
- This technology of water filtration will help 3.8 crore people who affected by water borne disease in India (WHO)
- Portable, cheap, non-electrical filter these are easy to access by mass consumers

Design

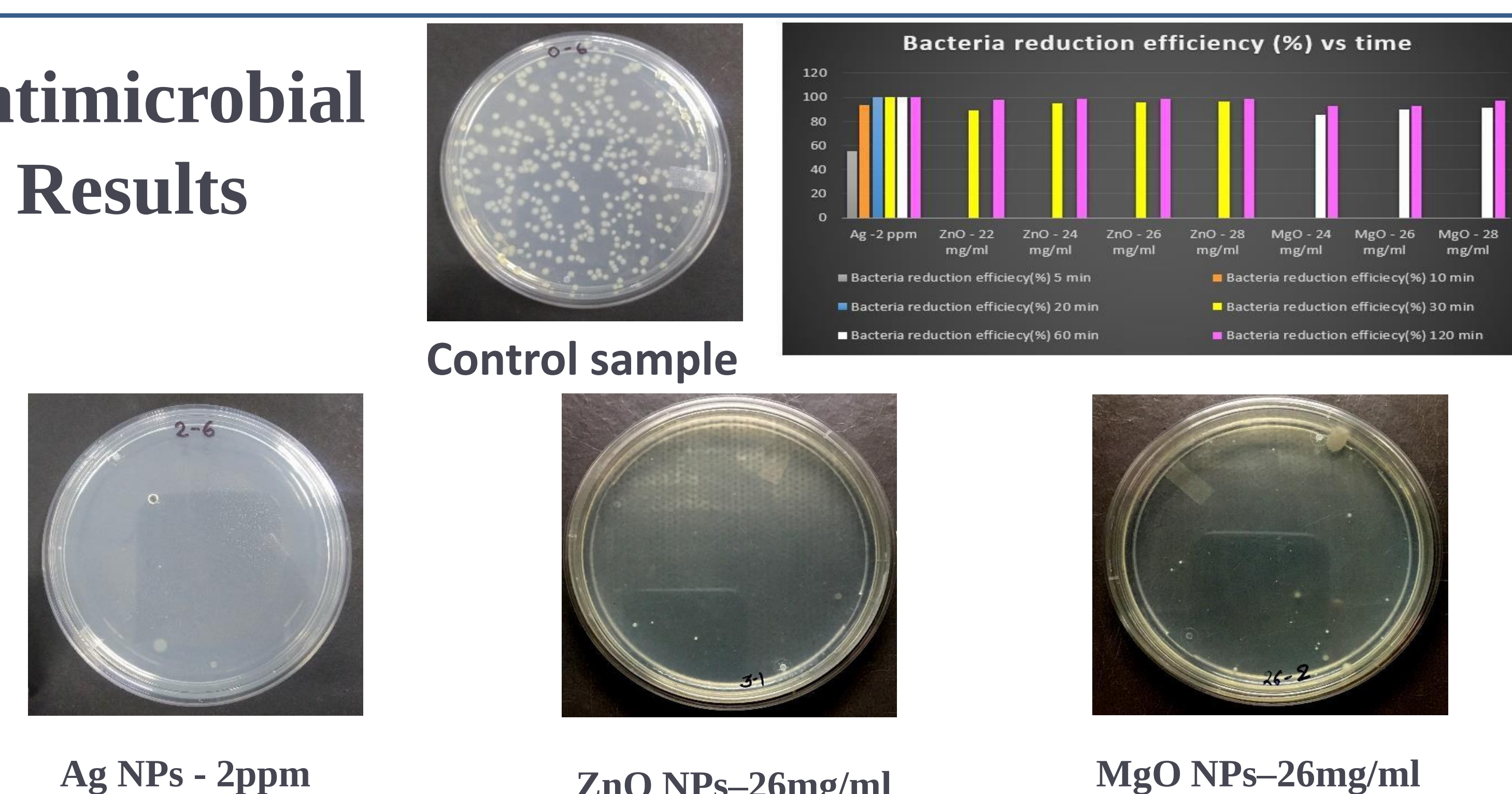


EDX analysis of Nanoparticles based fabric

S.N.	Sample	Conc.	Carbon(%)	Oxygen (%)	Zinc(%)	Magesium (%)	Silver (%)
1	ZnO	22 mg/ml	51.37	46.02	2.60	-	-
2	ZnO	24 mg/ml	48.67	47.25	4.08	-	-
3	ZnO	26 mg/ml	51.04	37.83	11.13	-	-
4	ZnO	28 mg/ml	45.37	40.79	13.84	-	-
5	MgO	24 mg/ml	48.50	50.18	-	1.32	-
6	MgO	26 mg/ml	47.47	51.03	-	1.49	-
7	MgO	28 mg/ml	45.00	52.71	-	2.29	-
8	Ag	2 ppm	50.94	46.76	-	-	2.13



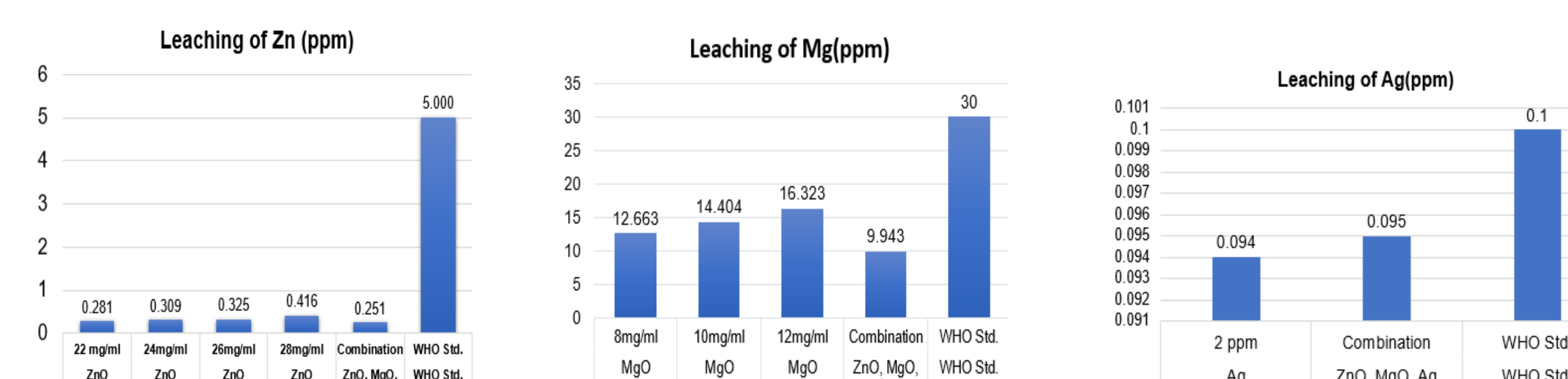
Antimicrobial Results



Leaching results(ICP-MS)

Flow rate – 1L/hour/5 cm²

Tap water: Zn- 0.15 ppm Mg- 9.3 ppm Ag- 0.021 ppm & pH-7



Reference

1. V.K. Kothari, A. Das and S. Singh, “Filtration Behavior of Woven and Nonwoven Fabrics”, Indian Journal of Fibre & Textile Research (2007)
2. Y. Gao and R. Cranston, “Recent Advances in Antimicrobial Treatments of Textiles”, Textile Research Journal (2008)
3. I.J. El Saliby, H.K. Shon, J. Kandasamy and S. Vigneswaran, “Nanotechnology for Waste Water Treatment”, Encyclopedia of Life Support Systems (EOLSS) (2011)